

Appln. No. 10/550,829
Amdt. Dated: January 23, 2008
Reply to Office Action of October 26, 2007

REMARKS

Claims 1 – 19 are currently pending. No new matter has been introduced by the amendment of the claims. Support for the amendment to claim 1 can be found on page 8, lines 1 through 27 of the present application. Claims 2 – 14, and 17 were amended for formal reasons to more particularly point out and distinctly claim Applicants' invention.

The Examiner has rejected claims 1 – 19 under 35 U.S.C. §§ 102 and 103. Applicants respectfully traverse the Examiner's rejections and request reconsideration and withdrawal of the rejections based on the following remarks.

Rejection of claims 1, 6, 8 – 10, 12 – 14, 17, and 19 under 35 U.S.C. § 102(b)

The Examiner rejected claims 1, 6, and 8 – 10 under 35 U.S.C. § 102(b) as being anticipated by either British Patent GB 1,546,524 to Shipley ("Shipley") or French Patent FR 2,392,100 to Goffinet ("Goffinet"). The Examiner also rejected claims 12 – 14, 17, and 19 under 35 U.S.C. § 102(b) as being anticipated by Goffinet. The Examiner asserts that Shipley and Goffinet disclose every element of Applicants' invention. Applicants respectfully disagree.

Shipley and Goffinet do not disclose every element of Applicants' invention. As currently amended, Applicants claim a bath for etching copper or a copper alloy comprising at least one substance selected from the group consisting of aromatic sulfonic acids, salts of aromatic sulfonic acids, aqueous solutions of aromatic sulfonic acids, and

aqueous solutions of salts of aromatic sulfonic acids wherein the bath has a sulfate ion concentration that is less than the product of 2 grams/liter and the volume percent of said at least one substance in the bath. Shipley and Goffinet do not disclose an etching bath having a sulfate ion concentration as claimed by Applicants.

In the current specification, Applicants disclose a preferred concentration that corresponds to that concentration of sulfate ion in the solution established if sulfate ion is brought into the solution by adding sulfate containing sulfonic acid or the salt thereof wherein the sulfate ion concentration in the sulfonic acid or the salt thereof is less than 0.2 % (w/v). The concentration corresponding to such a solution would be equal to the product of 2 grams/liter and the volume percent of the sulfonic acid or salt thereof in the final etching solution as demonstrated in the following proof:

C = concentration of sulfate ion in the etching solution

M = mass of sulfonic acid or salt thereof added to etching solution

P = specific gravity of sulfonic acid or salt thereof added to etching solution

V = volume of etching solution

$$C = M/P * 0.2\% \text{ (w/v)} * 1/V$$

M/P = volume of sulfonic acid or salt thereof added to etching solution = E

$$C = E * 1/V * 0.2\% \text{ (w/v)}$$

$E * 1/V = E/V$ = volume percent of sulfonic acid or salt thereof in the etching solution

$0.2\% \text{ (w/v)} = 0.2 \text{ grams of sulfate ion}/100 \text{ ml of sulfonic acid or salt thereof} = 2 \text{ g/L}$

Therefore, $C = 2 * E/V$.

As currently amended, the prior art references relied upon by the Examiner would have a sulfate ion concentration that far exceeds the limits of the bath claimed by Applicants. Commercial phenol sulfonic acid is not free of sulfate ions and contains generally between 2 and 5% sulfate ions. In the Office Action of October 26, 2007, the Examiner admits that Shipley and Goffinet each disclose the use of 20 g of phenol sulfonic acid in one liter of bath solution. The resulting sulfate ion concentration would be 0.4 g to 1 g per liter of bath solution which exceeds the limit currently claimed by Applicants. Applicants claim a bath in which the concentration of sulfate ions is less than the product of 2 g/L and the volume percent of sulfonic acid to the bath. Phenol-4-sulfonic acid is sold as a 65 % aqueous solution and has a density of 1.34 g/ml (As referenced in the scanned image of the web page for Sigma-Aldrich in the attached Appendix, found at <http://www.sigmaaldrich.com/catalog/search/ProductDetail/ALDRICH/171506>.) Therefore, in order to add 20 grams of sulfonic acid to the bath, you would need approximately 31 grams of aqueous solution. This amount of aqueous solution would have a volume of approximately 23 milliliters. The volume percent of the aqueous solution to a total bath of one liter would be 0.023 and multiplying this ratio by 2 g/l results in a concentration limit of sulfate ions of approximately 0.046 g/L. This is a sulfate ion concentration that is one order of magnitude less than the solutions taught by Shipley and Goffinet.

Applicants claim a bath having a low sulfate ion concentration. This concentration is achieved by reducing the number of sulfate ions which are naturally present. For

example, reacting the aromatic sulfonic acids with barium chloride will form a removable barium sulfate precipitate and reduce the sulfate concentration either prior to or after adding the aromatic sulfonic acid to the etching solution. Shipley's solution incorporates molybdenum compounds with an acid, a peroxide, and a stabilizer and Goffinet's solution includes mineral acids that are substantially made of a phosphoric acid, an oxidizing agent, a stabilizing agent, and a solvent. Neither of the solutions taught by Shipley and Goffinet includes aromatic sulfonic acids and salts thereof that are essentially free of sulfate ions or discloses an etching solution having a concentration that corresponds to that concentration of sulfate ion in the solution established if sulfate ions originated solely by adding an aromatic sulfonic acid or salt thereof that is free of sulfate ions. Because neither reference includes these elements, both references fail to anticipate claim 1, as well as all of the claims that depend from claim 1.

Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 102(b).

Rejection of claims 2-5, 7, 11, 15, 16, and 18 under 35 U.S.C. § 103(a)

The Examiner rejects 2 – 5, 7, 11, 15, 16, and 18 under 35 U.S.C. § 103(a). Based on the same conclusions in the prior Office Action, specifically relying on the assertion that Shipley and Goffinet teaches the invention substantially as claimed.

The references would not have suggested to a person having ordinary skill in the art at the time of Applicants' invention was made that Applicants' invention was obvious.

The references neither disclose all of the elements of Applicants' invention, nor do the references suggest the elements of Applicants' invention.

As previously discussed, Goffinet and Shipley fail to teach a solution wherein the solution has a sulfate ion concentration that corresponds to that concentration of sulfate ion in the solution established if sulfate ions originated solely by adding said at least one substance and if the sulfate ion concentration of said at least one substance is less than 0.2% w/v. The remaining references relied upon by the Examiner also fail to disclose all of the elements of Applicants' invention. Goffinet is concerned with including a phosphoric acid in a copper etching solution. Fairweather teaches a solution that includes an aromatic sulfonic acid and sulfuric acid. Hongo discloses a method and apparatus of etching a substrate. None of the references, either alone or in combination, disclose or suggest all of the elements of Applicants' invention.

By including aromatic sulfonic acids in an etching solution, a person who practices any of the solutions disclosed by Goffinet, Fairweather, or Hongo will have a solution with a high concentration of sulfate ions relative to Applicants' claimed solution because aromatic sulfonic acids are always accompanied by sulfate ions unless steps are taken to reduce the concentration of sulfate ions. The Examiner has also failed to provide any suggestion that would have been present for a person skilled in the art at the time of Applicants' invention to combine and modify the references to form a solution having a sulfate ion concentration that corresponds to that concentration of sulfate ion in the solution established if sulfate ions originated solely by adding aromatic sulfonic acids or

salts thereof having a sulfate ion concentration less than 0.2% w/v. Therefore, the references either by themselves or in combination would not suggest the claimed subject matter to a person having ordinary skill in the art at the time of Applicant's invention.

Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103(a).

CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that the claims presented herewith are patentable over the prior art of record and in condition for allowance. Applicants respectfully solicit prompt action thereon. If any questions remain, the Examiner is invited to phone the undersigned attorney.

Respectfully submitted,

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